Satellite Data (NRSC)

SPOT IMAGE

SPOT Catalogue Listing Description

CST 552
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Preface to the Manchester Reprint

This document is a striaght reprint of the manual produced by National Remote Sensing Centre Ltd. (NRSC) and SPOT IMAGE.

We are grateful to NRSC and SPOT IMAGE for permission to reproduce this manual for the higher education and research community in the U.K.

Reprinted at Manchester Computing, University of Manchester.

SPOT Catalogue Listing Description

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Scene ID Scene Identification Number consists of 21 characters representing:

Character 1:	satellite number (eg "2" = SPOT satellite No. 2)
Characters 2-4:	x-axis of the GRS grid node (KKK)
Characters 5-7:	y-axis of the GRS grid node (JJJ)
Characters 8-9:	year of the acquisition
Characters 10-11:	month of acquisition
Characters 12-13:	day of acquisition
Characters 14-15:	hour of acquisition (GMT)
Characters 16-17:	minute of acquisition (GMT)
Characters 18-19:	second of acquisition (GMT)
Character 20:	HRV instrument number (eg "1" = High Resolution Visible No. 1)
Character 21:	acquisition mode (eg. (P) Panchromatic, (XS) Multispectral)

SAT The 'Dummy' value expresses an incomplete scene.

Geographic coordinates of the scene corners in degrees, minutes and seconds of latitude and longitude.

NW CNR North West Corner Point
NE CNR North East Corner Point
SW CNR South West Corner Point
SE CNR South East Corner Point

CENTRE Geographic coordinates of the centre of the raw scene in degrees, minutes and seconds.

CLOUD Scenes acquired after 1991 are given cloud cover assessments based on segmenting a scene into eight sections. Each of the eight sections are analysed for cloud cover and graded with a letter which represents a percentage of cloud cover.

A = 0%
B = 1% to 10%
C = 11% to 25%
D = 26% to 75%
E = 76% to 100%

"ABCDEABC" listed in the catalogue represents the following configuration in a full SPOT scene:

A	B
C	D
E	A
B	C

Cloud cover criteria used for data collected prior to January 1991 is expressed numerically and the scene is segmented into 4 sections. A possible criteria is 0102 listed in the catalogue represents:

0 = < 10%
1 = 10% to 25% in cloud cover
2 = 25% or more

0	1
0	2

SNOW Snow cover assessment for images collected after January 1991 is segmented into eight sections and given the numbers 1 or 0 to describe the amount of snow present in each of the eight sections.

0 = no snow
1 = presence of snow

The sequence of 0110001 would represent:

0	1
1	0
0	0
1	1

TQ Technical quality grade for the scene concerned and is expressed as:

E = excellent
P = poor
G = good
U = unusable

ORB Orbit number is the number of the reference track passed over during 26-day orbit cycle, the satellite accomplishes 369 revolutions. The reference tracks are numbered from West to East, with continuous numbering of adjacent satellite tracks. By convention, reference track 1 is the track that intersects the Equator at longitude 330.24 degrees.

INCID Angle between the look direction at the scene centre and a line perpendicular to the reference ellipsoid. Angle of incidence is expressed in degrees and tenths of degrees.

ORIEN Angle through which the image centreline direction must be rotated in order to align with true east at the centre of the raw image. Image orientation is expressed in degrees and tenths of degrees.

DKM Scene centre to KJ node; distance in KM.

CONF HRV configeration. HRV is High Resolution Visible imaging instrument. The options under CONF in the catalogue listing are:

I: Independent - Each instrument operates independently in each spectral mode (XS and P).

T: Twin - The pair of HRV instruments is configured in such a way that the instrument's acquisition strips overlap slightly, by means of the particular orientation of the two strips selection mirrors.

D: Dual - Only one of the instruments is used in P+XS mode and it performs two acquisitions in different spectral modes (XS and P). The other instrument is inoperative.

GAIN Gain value used for each spectral band. Relates to the spectral response of the instrument at the time of receiving the data. The values represent the mean values of measurements corrected for methodical effects, (in particular, air-vacuum transition). Individual detectors will give a slightly different response about this mean value. The order of magnitude is 5 to 10 nm.

V-ANG Viewing angle. Angle made, in HRV object space, between the geocentric direction and the vector to the centre of the HRV field of view. Acquisition angle is expressed in decimal degrees.

AZIM/SITE Sun Azimuth and elevation angles at the scene centre at the moment the centre pixel is acquired, as indicated in the 'viewing date' field.

SPOT IMAGE	THE SPOT STANDARD CD-ROM FORMAT	DATE éd1 : 11/6/1992 EDITION : 1 REVISION : 0 DATE : 11/6/1992 PAGE :
REF. SPOT IMAGE : SI/DPST/SDL/92.304		REF PROJET: S-ST-C-10-SI

THE SPOT STANDARD CD-ROM FORMAT

	NOM ET FONCTION	DATE	SIGNATURE
Préparé par :	C.SAINT-GERMAIN	12/6/92	
Approuvé par :	G.POISSONNIER	12/6/92	
Application autorisée par :	Ph.DELCLAUX	12/6/92	

SOMMAIRE

1. SCOPE

This document defines the format of the CD-ROM's which are produced by SPOT IMAGE, for users distribution .

This definition concerns the SPOT products which are preprocessed at SPOT IMAGE, and which are delivered on CD-ROM .

2. APPLICABLE DOCUMENTS

[DA1] "Information processing - Volume and file structure of CD-ROM for information interchange " Ref : International Standard Organisation (ISO) 9660 .

[DA2] "SPOT STANDARD CCT FORMAT" Ref : SI/AT/85.0113

FOREWORD

Additionnal information if any updating of the attached will be provided as it becomes available.

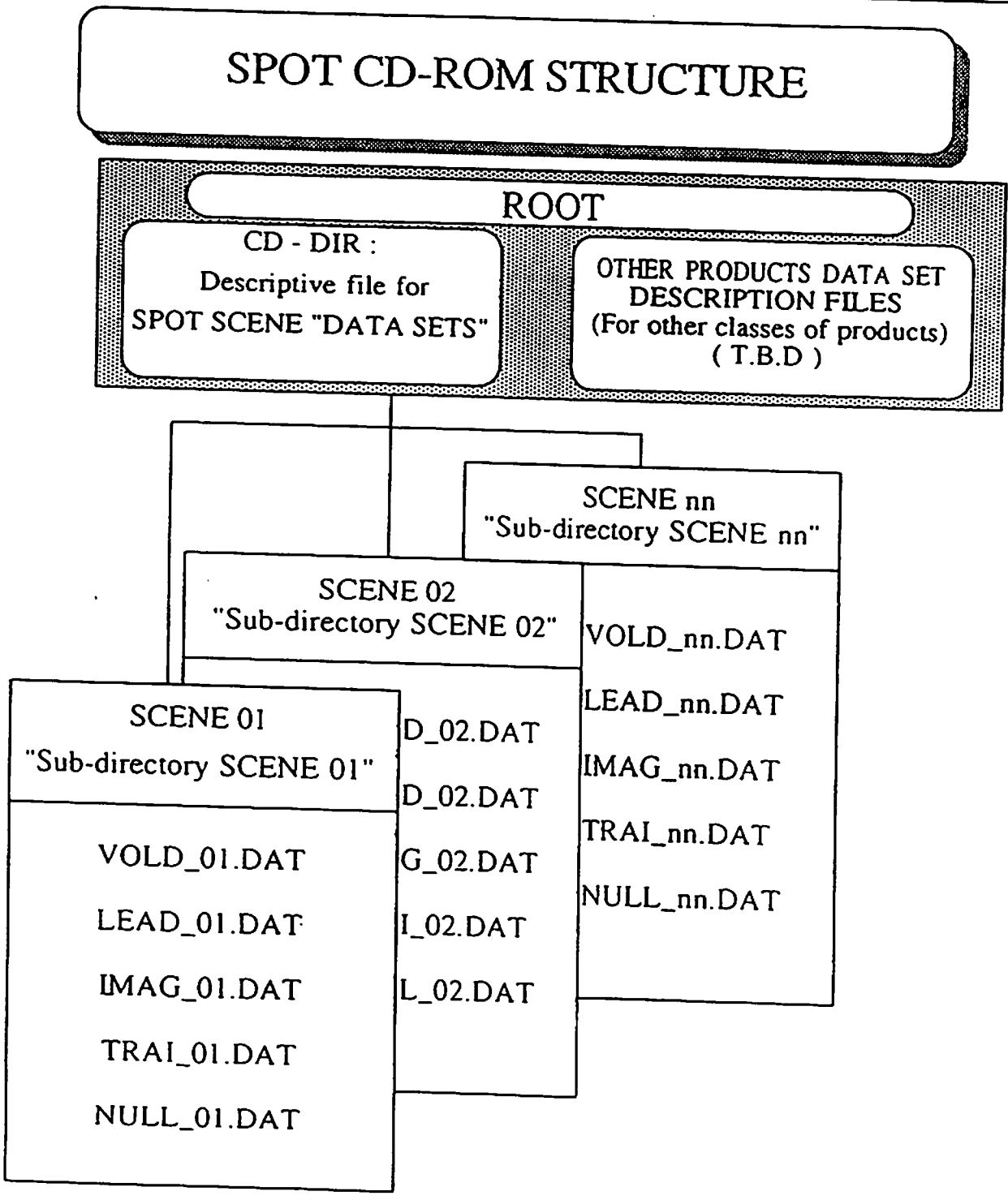

SPOT CD-ROM STRUCTURE
ROOT
CD - DIR :
Descriptive file for
SPOT SCENE "DATA SETS"
OTHER PRODUCTS DATA SET
DESCRIPTION FILES
(For other classes of products)
(T.B.D)
SCENE nn
"Sub-directory SCENE nn"
SCENE 02
"Sub-directory SCENE 02"
VOLD_nn.DAT
LEAD_nn.DAT
IMAG_nn.DAT
TRAI_nn.DAT
NULL_nn.DAT
SCENE 01
"Sub-directory SCENE 01"
D_02.DAT
D_02.DAT
G_02.DAT
I_02.DAT
L_02.DAT
VOLD_01.DAT
LEAD_01.DAT
IMAG_01.DAT
TRAI_01.DAT
NULL_01.DAT

FIGURE 1

3. SPOT CD-ROM PRODUCT DESCRIPTION

3.1 CD-ROM PHYSICAL DESCRIPTION

A Compact-Disk Read Only Memory capacity is about 540 Megabytes. It may be used on every system (PC, MACHINTOSH, SUN(UNIX STATIONS), DEC (VMS), etc...) which CR-ROM drive is conform to the Internal Standard Organisation 9660 .

3.2 CD_ROM LOGICAL DESCRIPTION

A CD-ROM may contain several sets of data called "Data Sets".

A "Data Set" is equivalent to a product (i.e there is a product code for each data set).

A "Data Set" may be a SPOT Scene, processed at a standard processing level (Level 1A, 1B, 2A, 2B, P+XS...), or another class of product (To Be Defined; GEOSPOT for example).

A CD-ROM may be considered by every system as a classical magnetic disk. Therefore, it has a hierachically directory structure.

The CD-ROM is organized with as many directories as "Data Sets", and one "Data Set" is recorded in one directory.

For a SPOT Scene "Data Set" , ancillary data and image data are included in one directory.

The root directory contains files which are used as a DIRECTORY for the identification of the Data Sets.

These files consist in:

. A text file named CD-DIR for scenes "Data Set"

. Other files for other classes of products (To Be Defined), if necessary.

Then, the CD-ROM contains :

. A set of nn sub-directories named SCENEnn, nn varying from 01 to 99.

. Other sub-directories (T.B.D) for other classes of products.
(See Fig. 1)

3.2.1 CD-DIR FILE DESCRIPTION

3.2.1.1 FOR A SPOT "SCENE DATA SET"

The CD-DIR File is a text file which contains the main informations (in ASCII code) needed to identify a "Scene Data Set".

There is one record per Data Set.

For each "Scene Data Set" delivered on the CD-ROM support, those informations are :

. SCENEnn : Scene directory name (0 < nn ≤ 99)

. SCENE ID : Scene identification in the form :

SKKKJJJYYMMDDHHMNSSIX

where :

S	: satellite number
KKK JJJ	: K,J scene designators
YYMMDD	: Viewing date (Year,Month,Day)
HHMNSS	: Viewing time (Hour,Minute,second)
I	: HRV number
X	: Spectral viewing mode (P,M,X or J)

. Shift Along The Track value : /N (0 ≤ N ≤ 9)

(Ex: /5)

. Spot-Image Product code : TA0200L, TB0200L, TD0200L, TE0200L, TS0200L,TU0200L,TA0500L, TB0500L, TD0500L, TE0500L, TS0500L or TU0500L.

These codes correspond to the products delivered by Spot-Image (See [DA2] § 3.4)

. Spot-Image Product code explanation : T.B.D

3.2.1.2 FOR OTHER TYPES OF "DATA SETS"

To Be Defined Later

3.2.2 CONTENT OF THE SUBDIRECTORIES

3.2.2.1 SUBDIRECTORIES FOR "SCENES DATA SETS'

Each sub-directory contains 5 files which are identical to the files delivered for a BIL, ASCII, NOSPLIT and 6250 bpi product on a single tape (See [DA2] § 4.2).

For the sub-directory corresponding to the scene number nn, the filenames are :

VOLD_nn.DAT	for Volume Directory
LEAD_nn.DAT	for Leader File
IMAG_nn.DAT	for Imagery File
TRAI_nn.DAT	for Trailer File
NULL_nn.DAT	for Null Volume Directory
	($0 < nn \leq 99$)

The VOLD_nn.DAT, LEAD_nn.DAT, IMAG_nn.DAT, TRAI_nn.DAT, NULL_nn.DAT desriptions are the same as for the CCTs (as described in [DA2]).

3.2.2.2 SUBDIRECTORIES FOR OTHER TYPES OF PRODUCT "DATA SETS"

To Be Defined Later

CD-ROM DEMONSTRATION CONTENT

SCENE NUMBER	01	02	03	04	05	06
IMAGE NAME	*La Camargue, France*	*La Camargue, France*	*New-York, USA*	*Aix-en-Provence, France*	*Aix-en-Provence, France*	*Mossoul, Irak*
GRS ref (K-J)	048-262	048-262	627-268	051-262	051-262	132-277
Date	87/01/12	87/01/17	86/07/08	86/03/22	86/05/11	91/02/22
Time	10:27:14	10:31:04	15:48:20	10:19:32	10:58:20	8:13:05
Satellite	SPOT1	SPOT1	SPOT1	SPOT1	SPOT1	SPOT2
Instrument	HRV1	HRV1	HRV1	HRV1	HRV1	HRV2
Incidence Angle	R 25.5	R 20.7	R 13.1	R 30.4	L 25.1	L 15.8
Processing Level	1B	1B	1B	1A	1A	1B
Spectral Mode	XS	XS	P+XS	PAN	PAN	PAN
Spectral band number	3	3	3	1	1	1
Imagery file record length	5400	5400	8640	8640	8640	8640
Imagery file record number	8974	8983	17983	6001	6001	6012
Center geographical coordinates	N43°40'26" E4°36'15"	N43°59'22" E4°31'51"	N40°45'52" W74°03'01"	N44°02'23" E5°37'52"	N43°40'23" E5°37'55"	N36°22'02' E43°04'47"
1st corner geographical coordinates	N43°59'25" E4°13'40"	N43°59'22" E4°11'25"	N41°04'37' W74°20'26"	N44°02'23" E5°15'29"	N44°02'37" E5°21'34"	N36°41'22" E42°49'18"
2nd corner geographical coordinates	N43°53'04" E5°07'01"	N43°53'05" E5°01'13"	N41°58'39" W73°36'19"	N43°56'04" E6°07'34"	N43°52'21" E6°09'17"	N36°33'54" E43°31'24"
3th corner geographical coordinates	N43°27'45" E4°04'44"	N43°27'44" E4°01'59"	N40°33'01" W74°29'58	N43°24'44" E5°07'05"	N43°28'05" E5°07'41"	N36°09'58" E42°38'46"
4th corner geographical coordinates	N43°21'29" E4°57'38"	N43°21'31" E4°51'22"	N40°27'07" W73°46'11"	N43°18'29" E5°58'39"	N43°17'55" E5°54'60"	N36°02'34" E43°20'35"
1st corner pixel coordinates	0001,0137	0001,0139	0001,0323	0001,0001	0001,0001	0001,0319
2nd corner pixel coordinates	0001,3756	0001,3522	0001,6604	0001,6000	0001,6000	0001,6745
3th corner pixel coordinates	2991,0001	2994,0001	5994,0001	6000,0001	6000,0001	6011,0001
4th corner pixel coordinates	2991,3620	2994,3384	5994,6283	6000,6000	6000,6000	6011,6427

NOTA :

. The XS Imagery files are Band Inter-leaved encoded and the spectral bands order is Band1, Band2, Band3 (i.e one line Blue,one Green and one Red, and so on.)

. There is one record at the beginning of each Imagery file to be skipped to read the Image data.

. There is a prefix of 32 bytes at the beginning of each Image record .

1 - INTRODUCTION

When defining a product to be marketed in the form of computer-compatible tapes (CCTs), definition of a suitable data storage format on the magnetic medium is a critical problem.

A worldwide standard for CCT tapes does exist for writing and reading binary data on magnetic CCTs. This standard ensures that tapes recorded by one computer can be read by any other type of computer.

However, no such standard exists for **data storage formats. Each product has its own format,** with the result that special-purpose software must be written to decode each format in order to allow users access to the stored information.

In the field of digital remote sensing imagery data, a standardization effort was undertaken by the Landsat Ground Stations Operators Working Group (LGSOWG) (see Appendix 9, Volume 3).

Similarly, when defining a format for SPOT data recorded on magnetic tape, in-depth consideration was given to this critical problem by both CNES and SPOT IMAGE.

This work led to definition of a CCT format in compliance with the LGSOWG recommendations while at the same time giving users access to the widest possible range of auxiliary data concerning the conditions of image acquisition.

This chapter describes the basic concepts underlying the SPOT CCT format and the means by which users may access the main data stored on such tapes. For more detailed information, please refer to "The SPOT Standard CCT Format", published and distributed by SPOT IMAGE (ref. SI/AT/86.0113).

2 - GENERAL DESCRIPTION

Physically, a SPOT CCT tape consists of a succession of **"records"**. Records containing analog data are further grouped together in **"files"**.

Each tape of a given length is further characterized by its **"physical volume"** which corresponds to the quantity of data or the number of files that can be recorded on it.

The set of files containing all information and data concerning a given product may be recorded on one or more CCTs. This constitutes the concept of **"logical volume"**.

2.1 - RECORDS

Data are stored on magnetic tapes in the form of 8-bit bytes. However, when reading a tape, the unit of information accessed by the computer is the "record".

A record is a succession of bytes separated from the following record by an Inter Record Gap (IRG).

In accordance with LGSOWG recommendations, each record of the SPOT format corresponds to a multiple of 180 bytes.

A record is characterized by its type (only one in the SPOT format) and its sub-type (of which there are three). As a general rule, CCTs containing satellite remote sensing data make virtually no use of sub-types 2 and 3.

The first 12 bytes of each record contain only binary numbers describing the record itself. The fields in question are as follows:

bytes 1 to 4:	Record number
byte 5:	First record sub-type code
byte 6:	Record type code
byte 7:	Second record sub-type code
byte 8:	Third record sub-type code
bytes 9 to 12:	Record length

The type and sub-type codes for each SPOT format record are given in document SI/AT/86.0113.

Bytes 13 and on contain data stored in a structured fashion.

A record is characterized by its length, expressed as a number of bytes, and by its structure.

2.2 - FILES

Records may be grouped together to form files; all data assembled in a given file is of the same type (e.g. image data, auxiliary data, format descriptor, etc.).

Each file is separated from the following file by a special type of record known as an End Of File tape marker or EOF.

For the SPOT format, all records in a given file are of the same length (multiple of 180 bytes).

In addition, the first record of each file contains a description of the file structure. This record includes a "fixed-structure segment" common to all files, and a segment whose structure is determined by the types of data stored in the file.

The fixed-structure segment carries information concerning data encoding and the location of data describing the record.

2.3 - PHYSICAL VOLUME

The concept of "Physical volume" is fundamental to the SPOT format because of the volume of data contained in a SPOT image: a single CCT tape may be insufficient to accommodate a complete SPOT image.

Each physical volume begins with a file known as the Volume Directory File and ends with two EOFs. These two EOFs are together termed an End Of Volume marker, or EOV.

2.4 - LOGICAL VOLUME

The logical volume is the complete set of files containing all data corresponding to a particular product. Physically, these files may be stored on one or more CCTs.

Each logical volume ends with a special file known as the Null Volume Directory and three EOFs together known as an End Of Set marker, or EOS.

3 - DETAILED DESCRIPTION

3.1 - RECORDS AND FILES

The records and files of a SPOT CCT may be recorded using different forms characterized by the following computer hardware or software options:

- recording density,
- file organization,
- coding schemes,
- record length.

The following paragraphs provide the necessary information to allow users to chose the format best suited to the computer they intend to use when reading the CCTs.

The preferred options must, of course, be indicated on each order for a SPOT CCT product.

3.1.1 - Recording Density

Most currently available tape drives are designed to read CCTs recorded at 6,250 bpi (bits per inch), or 1,600 bpi, hence the choice between these two densities.

Before ordering a SPOT CCT product, check that a tape drive compatible with the requested tape density is available. Note also, in any case, that virtually all tape drives can reproduce tapes recorded at 1,600 bpi.

Note further that a complete preprocessed SPOT scene represents a data volume of between 27 and 100 Mbytes and therefore two or even three 1,600 bpi CCTs will be required (whereas a single 6,250 bpi CCT will suffice in all cases).

3.1.2 - File Organization

In **the multispectral mode,** the relative physical position of records corresponding to the different spectral bands depends on whether the user chooses the Band-Interleaved-by-Line (BIL) option or the Band-SeQuential (BSQ) option.

- **With the BIL option,** there is only one imagery file for all three spectral bands, i.e. each image line corresponds to three records, the first for spectral band XS1, the second for spectral band XS2, and the third for spectral band XS3.
- With the BSQ option, each spectral band constitutes a separate logical volume. There are therefore 3 logical volumes, each one comprising several files and in particular an auxiliary data file and an imagery file. XS1 spectral band data are contained in the imagery file of the first logical volume, XS2 spectral band data in the imagery file of the second logical volume, and XS3 image data in the imagery file of the third logical volume.
  The auxiliary data corresponding to each imagery file are contained in the other files on the same logical volume. The minimum number of CCTs required is therefore three (one per logical volume).

The choice between the BIL and BSQ systems of file processing depends essentially on which one the user is more used to in his image processing.

If the user has no particular preference, SPOT IMAGE recommends the BIL option since it best meets the majority of needs.

3.1.3 - Coding Schemes

Modern-day computers use either of two methods of character encoding, depending on the manufacturer. These codes are:

- **ASCII**, which uses 7 bits per character plus an additional bit reserved as either an extension of the character set or as a parity bit;
- **EBCDIC**, which uses eight bits per character (although not all codes correspond to characters).

Note, however, that computers can generally be made to read tapes recorded using a different coding scheme than that normally used by means of suitable additional software.

The two coding schemes offered by SPOT IMAGE are ASCII without parity bit and EBCDIC.

3.1.4 - Record Length

A record corresponds to an image line while the number of pixels making up a line depends on the instrument viewing angle and the preprocessing level. The number of bytes making up an image-line record may thus vary significantly.

However, as certain computers can only accommodate records of 4,096 bytes or less, a distinction is made between so-called **standard-length records** and **short records**.

With **standard length records**, the number of bytes per image record is determined directly by the viewing conditions and the preprocessing level.

Example: consider an XS image acquired at a viewing angle of 27°, preprocessed to level 1B, and comprising approximately 4,000 pixels per line (after 20 m resampling), instead of the 3,000 pixels per line in the raw scene.

Consider also a panchromatic image pre-processed to level 2 and comprising 10,200 pixels per line.

SPOT scenes recorded on CCT tapes can be supplied with three standard record sizes, as follows:

- 5,400 bytes per record (30 . 180),

- 8,640 bytes per record (48 . 180),

- 10,980 bytes per record (61 . 180).

In the case of **short records**, standard data blocks are subdivided into two or three blocks of 3,960 bytes each (22 x 180).

Note: The short record option is also termed "split record". The "split-record" option should only be selected in cases where the customer's computer cannot read records of more than 4,096 bytes as this option renders CCT reading more complicated.

3.2 - LOGICAL STRUCTURE

Where a SPOT product recorded on CCTs occupies a "logical volume" as defined above, there are five different types of files.

Two are directly related to the format structure detailed in section 2.2:

- Volume Directory File(s),
- Null Volume Directory File.

The three others contain information specific to SPOT image data:

- Leader File, essentially containing auxiliary data relating to the image in the Imagery file,
- Imagery File containing image data, and
- Trailer File containing information concerning preprocessing operations performed on the raw image data.

3.2.1 - Volume Directory File

The Volume Directory File is directly related to the format structure and contains information describing the tape contents. It comprises five 360-byte records of which there are three types:

- a Volume Descriptor record,
- three File Pointer records, and
- a Text record.

The Volume Descriptor record contains identification information concerning the CCT and the recording format.

The File Pointer records contain descriptions of the different files and, in particular, information concerning the data recording format.

The Text record contains a plain language text identifying the CCT.

3.2.2 - Leader File

This file **contains auxiliary data** concerning the image; it comprises 27 3,960-byte records of which there are 8 types:

- File Descriptor record,
- Header record,
- Ephemeris/Attitude record,
- 18 Radiometric/Calibration records
- 3 Histogram records,
- Map projection record,
- GCP record,
- Annotation record.

The **File Descriptor record** contains information describing the file and the position within each record of data relevent to this type of file.

The **Header record** contains all data describing the viewing parameters and the preprocessing performed on the raw image.

The **Ephemeris/Attitude record**, as the name implies, contains ephemeris data for the scene and satellite attitude rates during image acquisition. This record also contains the end detector look directions and the coefficients of the deformation model used to generate a level 1B product. These data are found on digital products of all levels.

The **Radiometric/Calibration records** give the relative inter-detector gains as well as the dark current values used for detector response normalization.

The **Histogram records** contain, as their name indicates, histograms computed from the image data.

The **Map Projection record** contains information relating to the map projection used in the preprocessing of level 2 and level S2 products.

The **GCP (Ground Control Point) record** gives the characteristics of all GCPs used in level 2, S1 and S2 products.

The **Annotations record** contains all information written on the precision film (see section 3.5, Chapter 3).

3.2.3 - Imagery File

The Imagery File **contains the brightness counts** (pixel values) corresponding to all image pixels, including fill pixels. The number of records contained in the Imagery File depends on three parameters:

- number of spectral bands (determined by the spectral mode, i.e. P or XS),
- number of image lines (which depends on the level of preprocessing and hence on the deformation model used),
- option, left open to the customer to request the splitting of image data into several records (records of non-standard length (1) known as the "split-record" option).

Record size depends on the number of pixels per image line and hence, like the number of records, on the spectral mode, the preprocessing level*, and the viewing angle. Scene orientation and map projection are also determining factors for images preprocessed to level 2. However, the number of record sizes is limited to four:

- 3,960 bytes where an image line is recorded over several records,
- 5,400 bytes where the image line contains less than 5,300 pixels[1] (general case for XS images),
- 8,640 bytes where the image line contains fewer than 8,540 pixels[1] (level 1 and level S1 panchromatic images and certain level 2 and level S2 panchromatic images),
- 10,980 bytes where the image line contains fewer than 10,880 pixels[1] (certain level 2 and level S2 panchromatic images).

The Imagery File contains two types of records:

- a File Descriptor record, and,
- Image Data records.

The **File Descriptor record** contains information describing the file itself and the position within each record of data relevant to this type of file.

(1) Including border pixels

Image Data records contain the brightness counts (pixel values) of the different pixels making up the image, each preceded by a 32-byte prefix and followed by a 68-byte suffix. The actual image data therefore begin at byte 33 of each record. The image data are zero filled if the number of pixels per line[1] is less than the record size less the 100 prefix and suffix bytes. During reading, only the number of bytes corresponding to the number of columns in the image need to be taken into account (see section 4.1).

3.2.4 - Trailer File

This file contains two types of data: **information concerning image data quality and the geometric models used for certain preprocessing operations.** For level 1 products, the Trailer File comprises three 1,080-byte records each of a different type. For level 2B and level S products, two additional record types are added so that the total number of records is five or more. The different record types are as follows:

- File Descriptor record,
- Quality record,
- Geometric Transformation record,

and in the case of level 2B and level S products:

- Grid Parameter record, and,
- several Rectification Grid records.

The File Descriptor record contains information describing the file itself and the position within each record of the data relevant to this type of file.

The Quality record contains information concerning the quality of the raw image data and of the preprocessing.

(1) Including border pixels

The Geometric Transformation record contains the coefficients of the location polynomials and the polynomials used to compute the positions of geographic reference marks on precision films.

The Grid Parameter record gives the characteristics of the rectification grid used in the preprocessing of level 2B and level S products.

The Rectification Grid records give the positions of the nodes of the grid (level 2B) or registration points (level S) used for the preprocessing in question. Each record may accommodate up to 132 nodes or registration points.

3.2.5 - Null Volume Directory File

This file relates directly to the format structure. It comprises a single Volume Descriptor record (360 bytes) and **indicates the end of the logical volume.**

The Volume Descriptor record, which has the same structure as the Volume Descriptor record in the Volume Directory File, contains a subset of the information stored in the said record.

3.3 - PHYSICAL STRUCTURE

The physical structure of a CCT depends on the **recording density** chosen (6,250 bpi or 1,600 bpi) and on file organization (BIL or BSQ).

Depending on whether the user opts for a density of 6,250 bpi or 1,600 bpi, BIL scene data will occupy one or more CCTs.

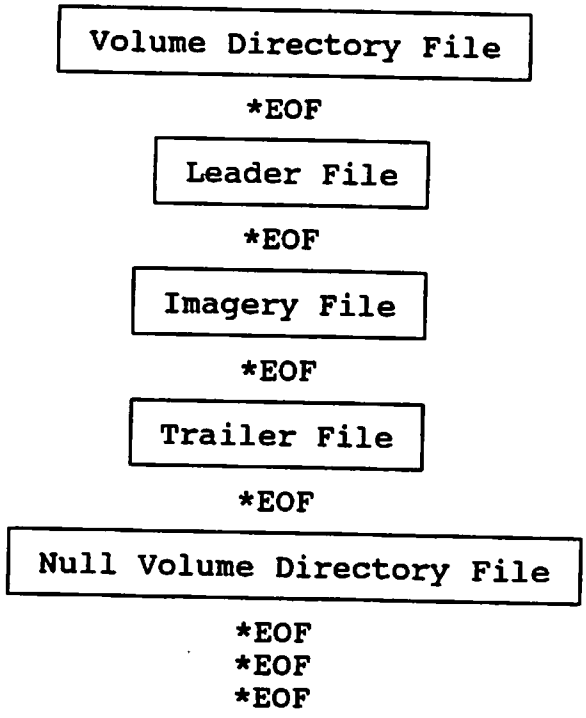
In the case of BSQ scene data, each spectral band will be stored on a separate physical volume.

The physical structure of SPOT CCTs is described below.

3.3.1 - Single Volume Case

Standard SPOT products stored on 6,250-bpi CCTs fit onto a single tape.

The tape structure is as follows(2):

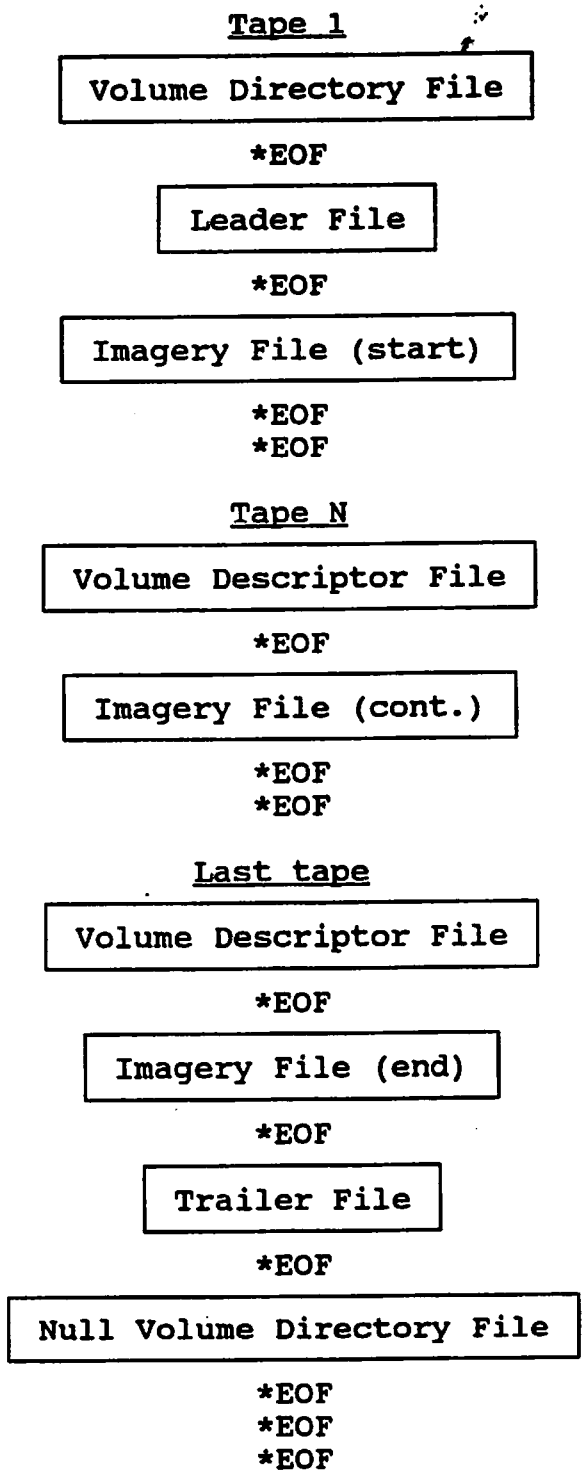


Note 1: EOF = End-Of-File marker.

Note 2: All 3 tapes supplied in the BSQ option are structured in this way.

3.3.2 - Multi-volume Case

The multi-volume case is directly applicable to standard SPOT products stored on 1,600 bpi CCTs. The tape structure is as follows.



Note 1: Tape N only exists if there are three or more tapes, in which case the tape N structure is applicable to all tapes except the first and last.

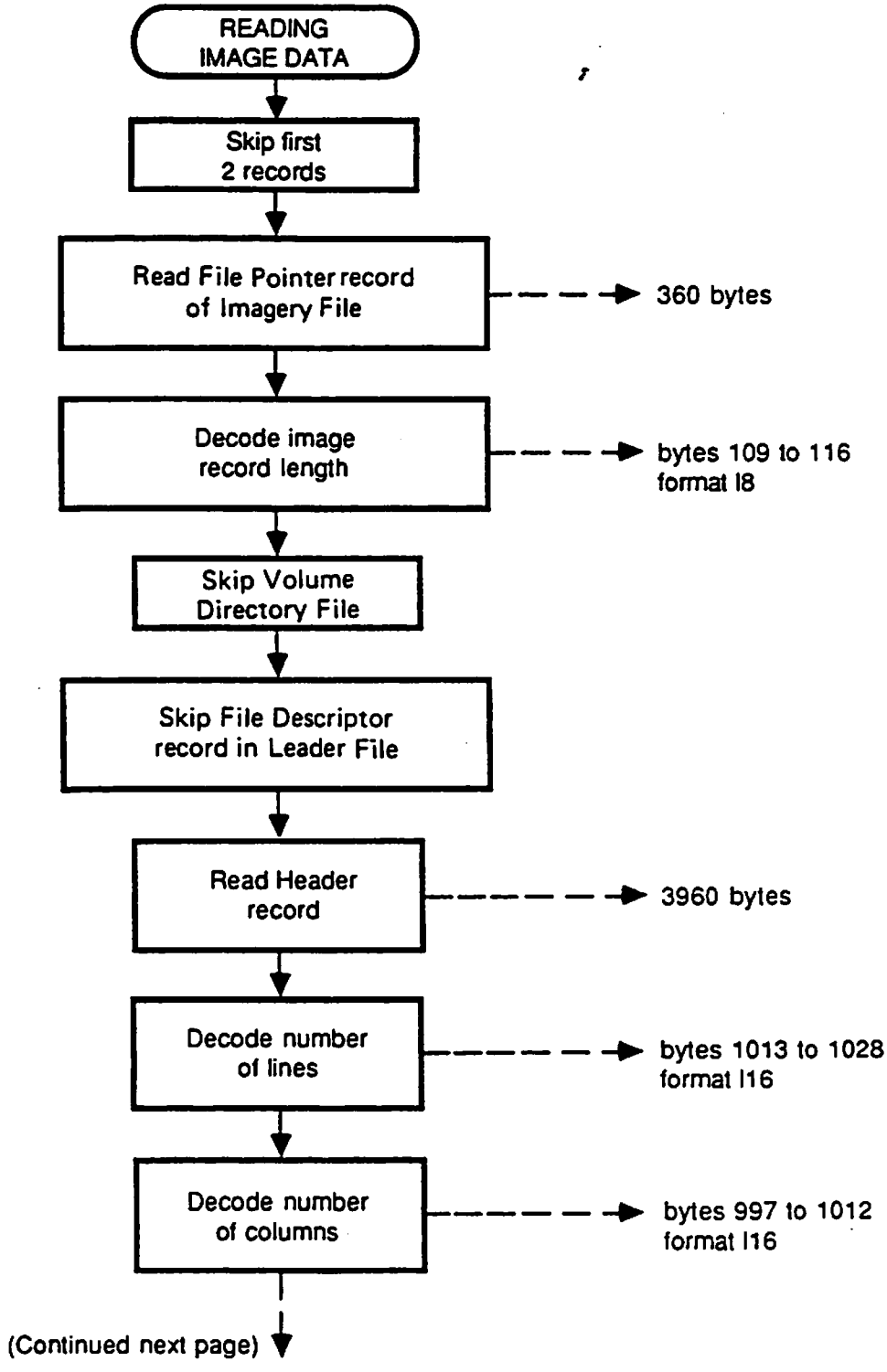
Note 2: The Imagery File Descriptor record is located at the beginning of the Imagery File on each tape.

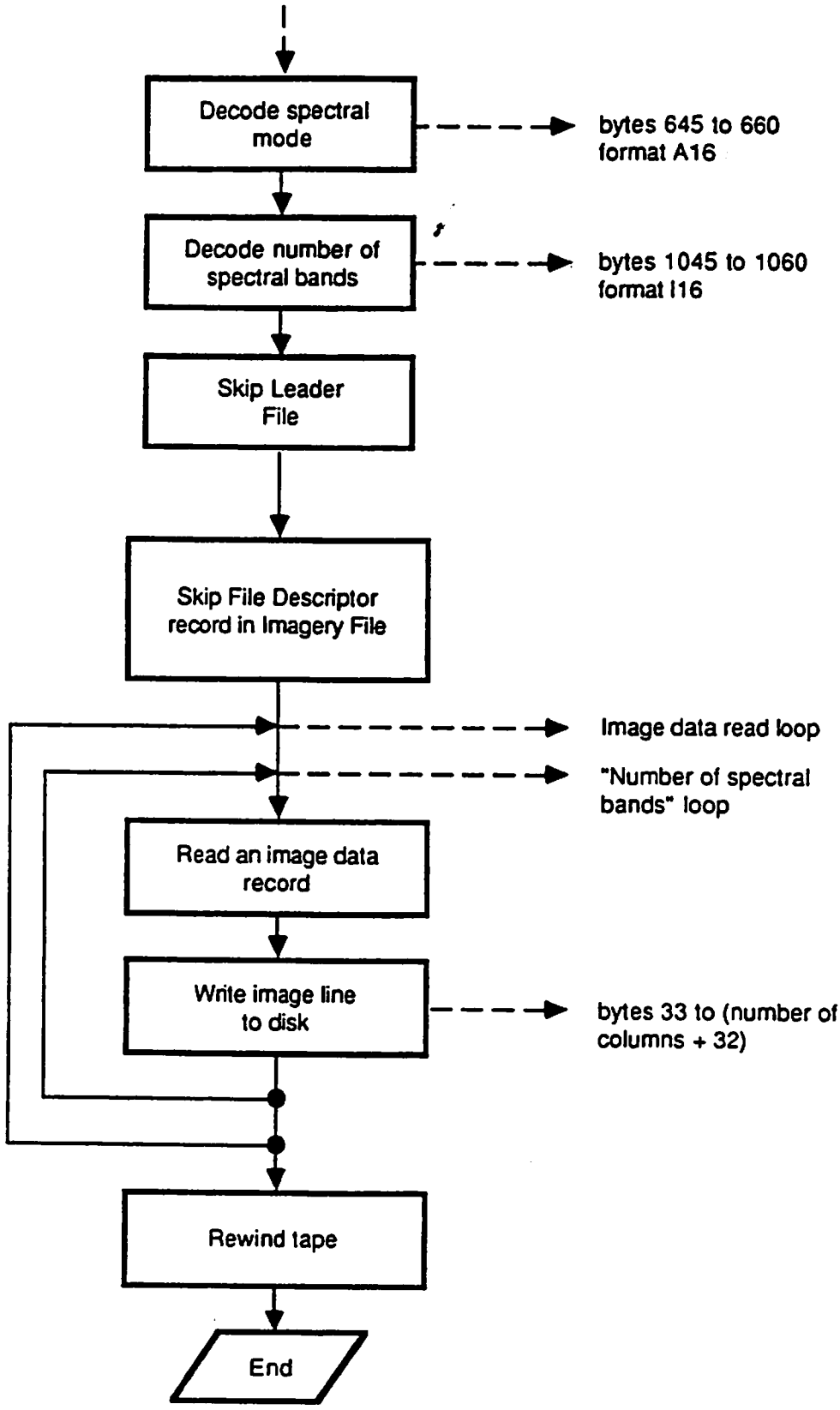
4 - EXAMPLE ALGORITHMS FOR READING SPOT CCTs

The purpose of this section is to give examples of program architectures giving access to data (image data, main auxiliary data) stored on CCTs recorded using the SPOT format.

Insofar as long-record (i.e. non-split) BIL image data in single-volume format are concerned, the algorithm consists simply in reading the Imagery File and writing these data to disk. This basic approach can be readily adapted to suit all other cases.

4.1 - READING IMAGE DATA

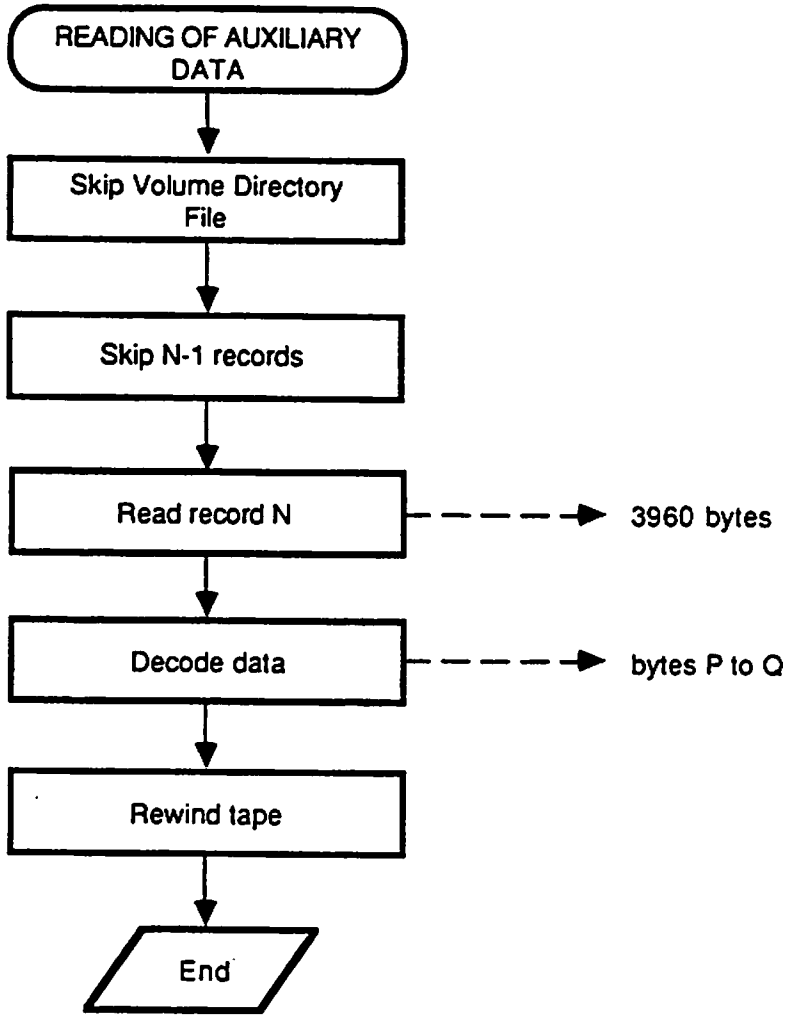




NOTE: Indications such as "Format I8" correspond to the general FORTRAN sense of the expression.

4.2 - READING AUXILIARY DATA

The example discussed here concerns the reading of auxiliary data in the Nth record of the Leader File between bytes P and Q. Further information concerning N, P and Q may be found in either the Auxiliary Data Sheets which follow, or document "SPOT standard CCT format".



5 - AUXILIARY DIGITAL DATA IDENTITY SHEETS

The development of algorithms for reading SPOT auxiliary data demands knowledge of a number of parameters required to gain access to the required item of auxiliary data on the CCT.

Headings under which this information is provided are listed below:

Generic name :

Description :

Location on tape :

- File number :
- File name :
- Record number :
- Record name :
- Byte numbers :

Coding type and unit:

- Coding type :
- FORTRAN coding format:
- Unit :

Observations :

In order to facilitate the use of the example algorithms detailed in section 4, an identity sheet has been prepared for each category of auxiliary data.

The following pages reproduce the identification sheets of the most commonly used categories of auxiliary data.

LIST OF AUXILIARY DATA SHEETS

CCT IDENTIFICATION

NUMBER OF CCTs

NUMBER IN CCT SET

CREATION DATE

ASCII OR EBCDIC ENCODING

IMAGE DATA RECORD LENGTH

SCENE GRS IDENTIFICATION

SCENE CENTER COORDINATES

SCENE CORNER COORDINATES

IMAGE ORIENTATION

ANGLE OF INCIDENCE

SUN ANGLES

VIEWING DATE

SATELLITE IDENTIFICATION

INSTRUMENT NAME

SPECTRAL MODE

SPECTRAL MODE P CODE

REVOLUTION NUMBER

NUMBER OF IMAGE LINES AND COLUMNS

PREPROCESSING LEVEL

MAP PROJECTION

MAP COORDINATES ORIGIN

ABSOLUTE CALIBRATION COEFFICIENTS

EPHEMERIS

JULIAN DATE AND TIME OF SCENE CENTER

ATTITUDE

LOOK DIRECTIONS

NORMALIZATION COEFFICIENTS

HISTOGRAMS

REFERENCE SCENE GRS IDENTIFICATION

REFERENCE SCENE TIME

REFERENCE SCENE SATELLITE IDENTIFICATION

REFERENCE SCENE INSTRUMENT IDENTIFICATION

REFERENCE SCENE SPECTRAL MODE

REFERENCE SCENE PREPROCESSING LEVEL

OFF-SET RELATIVE TO REFERENCE SCENE

AUXILIARY DATA IDENTITY SHEET

Generic name: CCT IDENTIFICATION

Description: number identifing the CCT

Location on tape:

- File number: 1
- File name: VOLUME DIRECTORY
- Record number: 1
- Record name: VOLUME DESCRIPTOR
- Byte numbers: 45 to 60

Coding type and unit:

- Coding type: 8 alphanumeric characters, left-justified in a 16-character field.
- FORTRAN coding format: A8, 8X
- Unit:

Observations:

AUXILIARY DATA IDENTITY SHEET

Generic name: NUMBER OF CCTs

Description: number of CCTs used for this scene

Location on tape:

- File number: 1
- File name: VOLUME DIRECTORY
- Record number: 1
- Record name: VOLUME DESCRIPTOR
- Byte numbers: 93 to 94

Coding type and unit:

- Coding type: 2 characters
- FORTRAN coding format: I2
- Unit:

Observations:

Equals 1 for 6250 bpi density and greater than 1 for 1600 bpi density.

AUXILIARY DATA IDENTITY SHEET

Generic name: CCT NUMBER IN CCT SET

Description: the number of the CCT in the set of CCTs containing the recorded scene.

Location on tape:

- File number: 1
- File name: VOLUME DIRECTORY
- Record number: 1
- Record name: VOLUME DESCRIPTOR
- Byte numbers: 99 to 100

Coding type and unit:

- Coding type: 2 characters
- FORTRAN coding format: I2
- Unit:

Observations:

always equal to 1 in the case of "SINGLE-VOLUME", greater than or equal to 1 in the case of "MULTI-VOLUME".

AUXILIARY DATA IDENTITY SHEET

Generic name: CREATION DATE

Description: date on which the CCT was created

Location on tape:

- File number: 1
- File name: VOLUME DIRECTORY
- Record number: 1
- Record name: VOLUME DESCRIPTOR
- Byte numbers: 113 to 120

Coding type and unit:

- Coding type: 8 characters YYYYMMDD
- FORTRAN coding format: A8
- Unit: year, month, day

Observations:

AUXILIARY DATA IDENTITY SHEET

Generic name: ASCII OR EBCDIC ENCODING

Description: the coding scheme used to record alphabetic and numeric characters in this file.

Location on tape:

- File number: 1
- File name: VOLUME DIRECTORY
- Record number: 2 and 4
- Record name: POINTER FOR LEADER FILE AND TRAILER FILE
- Byte numbers: 13

Coding type and unit:

- Coding type: 1 character
- FORTRAN coding format: A1
- Unit: A signifies ASCII
  E signifies EBCDIC

Observations:

this character is always coded in ASCII.

AUXILIARY DATA IDENTITY SHEET

Generic name: IMAGE DATA RECORD LENGTH

Description: size of records in IMAGERY FILE

Location on tape:

- File number: 1
- File name: VOLUME DIRECTORY
- Record number: 3
- Record name: IMAGERY FILE POINTER
- Byte numbers: 109 to 116

Coding type and unit:

- Coding type: 8 characters
- FORTRAN coding format: I8
- Unit: number of bytes

Observations:

AUXILIARY DATA IDENTITY SHEET

Generic name: SCENE GRS IDENTIFICATION

Description: (K,J) coordinates of the scene

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 2
- Record name: HEADER
- Byte numbers: 21 to 36

Coding type and unit:

- Coding type: 2 3-digit numbers in a 16-character field
- FORTRAN coding format: 2I3, 10X
- Unit:

Observations:

See description of the SPOT reference grid (Appendix 1, Volume 3). The first number corresponds to the column K number.

AUXILIARY DATA IDENTITY SHEET

Generic name: SCENE CENTER COORDINATES

Description: geographic coordinates and image coordinates, expressed as line and column numbers, of scene center

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 2
- Record name: HEADER
- Byte numbers: 85 to 148

Coding type and unit:

- Coding type:
  - geographic coordinates over 32 characters
  - image coordinates over 32 characters
- FORTRAN coding format: 2 (A1, I3, I2, I2, 8X), 2I16
- Unit: geographic coordinates: latitude and longitude, respectively, in degrees, minutes and seconds;
  image coordinates: expressed as line and column numbers, in that order.

Observations:

The first character of each latitude is the letter N or S indicating the position (North or South) of the scene center relative to the equator. The first character of each longitude is E or W indicating the position (East or West) of the scene center relative to the Greenwich meridian.

AUXILIARY DATA IDENTIFICATION SHEET

Generic name: SCENE CORNER COORDINATES

Description: geographic coordinates and image coordinates, expressed as line and column numbers, of corners of the useful scene.

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 2
- Record name: HEADER
- Byte numbers: 149 to 404

Coding type and unit:

- Coding type: for each of the four corners:
  - geographic coordinates encoded over 32 characters
  - image coordinates encoded over 32 characters
- FORTRAN coding format: 4 (2(A1, I3, I2, I2, 8X), 2I16)
- Unit: geographic coordinates: latitude and longitude, respectively, in degrees, minutes and seconds; image coordinates: expressed as line and column numbers, in that order.

Observations:

The first character of each latitude is the letter N or S indicating the position (North or South) of the scene corner relative to the equator. The first character of each longitude is E or W indicating the position (East or West) of the scene corner relative to the Greenwich meridian.

The coordinates of the four corners are given in the following order:

- C_1: top left-hand corner on raw scene
- C_2: top right-hand corner on raw scene
- C_3: bottom left-hand corner on raw scene
- C_4: bottom right-hand corner on raw scene

AUXILIARY DATA IDENTITY SHEET

Generic name: IMAGE ORIENTATION

Description: angle through which the image centerline direction must be rotated in order to align with true east at the center of the raw image.

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 2
- Record name: HEADER
- Byte numbers: 437 to 452

Coding type and unit:

- Coding type: 16 characters
- FORTRAN coding format: 11X, F5.1
- Unit: degree (to 2 decimal places)

Observations:

The angle given is the 90° complement of the angle between the lines of the raw image and true north. The convention for the sign of the scene orientation angle is given in Appendix 7, Volume 3 (also see Figure 1-4, Chapter 1, Volume 1).

AUXILIARY DATA IDENTITY SHEET

Generic name: ANGLE OF INCIDENCE

Description: angle between the look direction at the scene center and a line perpendicular to the reference ellipsoid.

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 2
- Record name: HEADER
- Byte numbers: 453 to 468

Coding type and unit:

- Coding type: 16 characters
- FORTRAN coding format: A1, F4.1, 11X
- Unit: degree (to 2 decimal places)

Observations:

The first character has two possible values: L or R. L (for left) indicates that the satellite passed to the west of the scene center when the scene was acquired while R (right) indicates that it passed to the east of the scene center when the scene was acquired.

AUXILIARY DATA IDENTITY SHEET

Generic name: SUN ANGLES

Description: sun azimuth and elevation angles at the scene center at the moment the center pixel is acquired, as indicated in the "Viewing Date" field (see next sheet).

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 2
- Record name: HEADER
- Byte numbers: 469 to 500

Coding type and unit:

- Coding type: 2 angles over 16 characters
- FORTRAN coding format: 10X, F6.1, 11X, F5.1
- Unit: degree (to 2 decimal places)

Observations:

The first parameter corresponds to the sun azimuth angle and the second to the sun elevation angle.

AUXILIARY DATA IDENTITY SHEET

Generic name: VIEWING DATE

Description: date and time of scene acquisition

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 2
- Record name: HEADER
- Byte numbers: 581 to 612

Coding type and unit:

- Coding type: 32 characters
- FORTRAN coding format: I4, 512, I3, 15X
- Unit: year, month, day, hour, minute, second, millisecond.

Observations:

The time of image acquisition corresponds to the time at which the scene center pixel was acquired. The millisecond field is always 0.

AUXILIARY DATA IDENTITY SHEET

Generic name: SATELLITE IDENTIFICATION

Description: name and number of the satellite

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 2
- Record name: HEADER
- Byte numbers: 613 to 628

Coding type and unit:

- Coding type: alphanumeric over 16 characters
- FORTRAN coding format: A4, I1, 11X
- Unit: SPOTn, where n is the number of the SPOT satellite

Observations:

AUXILIARY DATA IDENTITY SHEET

Generic name: INSTRUMENT NAME

Description: name of instrument used to acquire scene in question.

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 2
- Record name: HEADER
- Byte numbers: 629 to 644

Coding type and unit:

- Coding type: 16 characters
- FORTRAN coding format: A16
- Unit: not applicable

Observations:

The only two possible instrument names are HRV1 and HRV2.

AUXILIARY DATA IDENTITY SHEET

Generic name: SPECTRAL MODE

Description: scene acquisition mode (i.e. multispectral or panchromatic)

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 2
- Record name: HEADER
- Byte numbers: 645 to 660

Coding type and unit:

- Coding type: 16 characters
- FORTRAN coding format: A16
- Unit: not applicable

Observations:

This field can only have one of two values: XS for multispectral or PAN for panchromatic.

AUXILIARY DATA IDENTITY SHEET

Generic name: SPECTRAL MODE P CODE

Description: For the panchromatic mode, indicates the type of code used (linear or DPCM) when the data in question is transmitted to the receiving station.

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 2
- Record name: HEADER
- Byte numbers: 693 to 708

Coding type and unit:

- Coding type: 16-character text
- FORTRAN coding format: A16
- Unit: not applicable

Observations:

Indicates the data transmission mode used in P mode, i.e. "P.lin" or "P.com" mode. With "P.com" mode the system can on preprocessing recover brightness counts (pixel values) from 1 to 254, even though the downlink transmission was effected with an average of 6 bits per pixel.
The value of the character chain is LINEAR for P.lin mode and DPCM for P.com mode.

AUXILIARY DATA IDENTITY SHEET

Generic name: REVOLUTION NUMBER

Description: the chronological number R of the revolution corresponding to the scene acquisition (inside the 26-day cycle).

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 2
- Record name: HEADER
- Byte numbers: 661 to 676

Coding type and unit:

- Coding type: 16 characters
- FORTRAN coding format: 13X, I3
- Unit:

Observations:

For further information concerning the revolution number R, refer to Appendix 1 or Chapter 2 of Volume 1.

AUXILIARY DATA IDENTITY SHEET

Generic name: NUMBER OF IMAGE LINES AND COLUMNS

Description: number of lines and columns making up the image as determined by the preprocessing level and spectral mode.

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 2
- Record name: HEADER
- Byte numbers: 997 to 1,028

Coding type and unit:

- Coding type: 2 parameters over 16 characters
- FORTRAN coding format: 2 I16
- Unit: column or line

Observations:

The first parameter gives the number of pixels per line and therefore the number of columns. The second gives the number of lines in the useful image.

Note: **The length of image data records is not determined by the number of columns. For more information on this subject, see the last part of section 3.2.3 in this manual.**

AUXILIARY DATA IDENTITY SHEET

Generic name: PREPROCESSING LEVEL

Description: 1A, 1B, 2A, 2B, S1 or S2

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 2
- Record name: HEADER
- Byte numbers: 1317 to 1332

Coding type and unit:

- Coding type: 2 alphanumeric characters, left-justified in a 16-character field
- FORTRAN coding format: A2, 14X
- Unit: values = 1A, 1B, 2A, 2B, S1 or S2

Observations:

AUXILIARY DATA IDENTITY SHEET

Generic name: MAP PROJECTION

Description: the projection used, in the case of levels 2 or S2.

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 2
- Record name: HEADER
- Byte numbers: 1413 to 1444

Coding type and unit:

- Coding type: 32 alphanumeric characters
- FORTRAN coding format: A32
- Unit:

Observations:

AUXILIARY DATA IDENTITY SHEET

Generic name: MAP COORDINATES ORIGIN

Description: map coordinates of the first pixel on the first line (case of level 2B).

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 2
- Record name: HEADER
- Byte numbers: 1,621 to 1,652

Coding type and unit:

- Coding type: 32 characters
- FORTRAN coding format: 8X, 2I12
- Unit: meters (X,Y)

Observations:

AUXILIARY DATA IDENTITY SHEET

Generic name: ABSOLUTE CALIBRATION COEFFICIENTS

Description: coefficients for computing the equivalent radiance of target objects from pixel brightness counts.

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 2
- Record name: HEADER
- Byte numbers: 1,765 to 2,276

Coding type and unit:

- Coding type: 3 coefficients over 8 characters
- FORTRAN coding format: 3 F8.5
- Unit: $W^{-1}.m^2.sr.\mu m$

Observations:

For panchromatic images, this record contains only one coefficient; for multispectral images, the three coefficients relate to spectral bands XS1, XS2 and XS3, respectively.

The mathematical relation used to compute radiance is:

$$L(k) = \frac{x(k)}{A_k}$$

where L(k) is the SPOT radiance required, x(k) the pixel brightness count and A_k the absolute calibration coefficient corresponding to spectral band k.

Note 1: If a non-standard gain is used, the A_k coefficient supplied with the data is recalculated for the gain in question.

NOTE 2: The absolute calibration coefficients A_k are used to compensate for the difference in sensitivity of two instruments which could otherwise result in a slight difference in the mean pixel brightness counts of two images in a twin pair.

AUXILIARY DATA IDENTITY SHEET

Generic name: EPHEMERIS

Description: satellite ephemeris data at the time of acquisition.

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 3
- Record name: EPHEMERIS/ATTITUDE
- Byte numbers: 21 to 920

Coding type and unit:

- Coding type: 9 sets of satellite coordinates and velocity data coded over 12 characters, plus corresponding date and time coded over 28 characters.
- FORTRAN coding format: position 3 (F9.3, 3X)
  velocity 3 (F9.6, 3X)
  date (2I5, 18X)
- Unit: position in km,
  velocity in km/s,
  date: Julian day and seconds in the day

Observations:

Depending upon the date and time of the scene center, there are 8 or 9 sets in this record (if there are 8 sets, bytes 821 to 920 are not significant).

Ephemeris data are provided for nine points spanning scene acquisition, the points being separated by intervals of one minute. The X,Y,Z position is given relative to a reference frame defined as follows:
- Z axis is the north direction of the Earth's polar axis
- X axis is in the equatorial plane and passes through the Greenwich meridian,
- Y axis is in the equatorial plane and perpendicular to the X axis.
- The three axes form a right-hand reference system.

Velocity vectors Vx, Vy Vz are given relative to the same reference frame.

The date is expressed as the Julian day number since January 1, 1950; time of day in seconds (e.g., 34 274 corresponds to 9 hours 31 minutes 14 seconds UT).

AUXILIARY DATA IDENTITY SHEET

Generic name: JULIAN DATE AND TIME OF SCENE CENTER

Description: the date and time of the scene center expressed in Julian days and seconds in the day, with the precision required for use of ephemeris for the purposes of scene location.

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 3
- Record name: EPHEMERIS/ATTITUDE
- Byte numbers: 965 to 990

Coding type and unit:

- Coding type: 26 characters
- FORTRAN coding format: 12X, I5, F9.3
- Unit: day number since 01/01/1950; seconds in day

Observations:

AUXILIARY DATA IDENTITY SHEET

Generic name: ATTITUDE

Description: satellite angular rates during scene acquisition.

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 3
- Record name: EPHEMERIS/ATTITUDE
- Byte numbers: 1,001 to 2,440 or 2,460

Coding type and unit:

- Coding type: 72 or 73 20-character sets each containing the image line number and the three angular rates
- FORTRAN coding format: I4, 3I5, 1X
- Unit: for attitude data: 10^{-6} degrees/second

Observations:

The SPOT bus measures angular rates once every 125 ms.

These rates are supplied (on CCTs and, also with films of levels 1A and 1AP; see section 5.2.1, Chapter 1) to enable users who so desire to make certain corrections for themselves (notably for stereoplotting).

The parameters are given in the following order:

- image line number,
- residual angular rate about yaw axis,
- residual angular rate about roll axis,
- residual angular rate about pitch axis.

There are either 72 or 73 sets in this record, depending on how the scene is framed (if there are 72, bytes 2,441 to 2,460 are not significant).

AUXILIARY DATA IDENTITY SHEET

Generic name: LOOK DIRECTIONS

Description: angles describing the look directions of the CCD detectors corresponding to the first and last pixels of the first and last lines.

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 3
- Record name: EPHEMERIS/ATTITUDE
- Byte numbers: 2,461 to 2,492

Coding type and unit:

- Coding type: 4 angles over 8 characters
- FORTRAN coding format: 4 (I4, I2, I2)
- Unit: degrees, minutes, seconds

Observations:

HRV look angles are defined relative to the attitude reference frame. The first angle ψ_x gives look direction rotation about the pitch axis, the second ψ_y about the roll axis. The sign conventions are given in Appendix 7, Volume 3.

The first two angles represent the ψ_x of the last and first pixels of the image line, the other two angles represent the ψ_y of the last and first pixels.

For a level 1A image (not resampled), the look angles coresponding to a pixel of any position may be obtained by linear interpolation from the above values.

AUXILIARY DATA IDENTITY SHEET

Generic name: NORMALIZATION COEFFICIENTS

Description: Relative calibration coefficients for detector response normalization. These coefficients are systematically applied for all preprocessing levels.

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 4 to 21
- Record name: RADIOMETRIC/CALIBRATION
- Byte numbers: 61 to 2060

Coding type and unit:

- Coding type: 1000 integer coefficients, each coded as binary numbers over 16 bits.
- FORTRAN coding format: not applicable
- Unit: no size

Observations:

Interdetector gains "g" are multiplied by 10,000.

Dark currents "c" are multiplied by 10.

There are 12 useful records for P mode and 18 useful records for XS mode (records 16 to 21 are not significant for mode P).

The first 6 records (the first 9, respectively) concern interdetector gains.

The following 6 records (the following 9, respectively) concern dark currents.

Each record contains 1000 coefficients arranged in ascending detector number order (only in the case of level 1A are detector numbers the same as pixel numbers; see section 3, Chapter 5).

In XS mode, records 1, 2 and 3 contain the gains for spectral band XS1; records 4, 5 and 6 the gains for band XS2, and so on (records 16, 17 and 18 contain the dark currents for spectral band XS3).

The normalization formula applied for each detector is as follows:

$$x_c = \frac{x_b - c}{g} \qquad (x_c = \text{corrected value})$$

Note: **The binary representation of an integer depends on the computer used. In this case, the binary value is right-justified in the 16-bit word with the highest-order bit to the left.**

AUXILIARY DATA IDENTITY SHEET

Generic name: HISTOGRAMS

Description: image data histograms

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 22 to 24
- Record name: HISTOGRAM
- Byte numbers: 33 to 2080

Coding type and unit:

- Coding type: 256 values each coded over 8 characters
- FORTRAN coding format: I8
- Unit: number of pixels

Observations:

For multispectral images, data concerning spectral band XS1 are stored in record 22, data concerning spectral band XS2 in record 23, and data concerning spectral band XS3 in record 24.

For panchromatic images, the only significant data are those stored in record 22.

Bytes 25-26 and 29-30 in each significant record give the line and column sampling rates, respectively, used for histogram computation (FORTRAN format I2). Note that border pixels are taken into account when these histograms are established meaning that a large number of points are at zero.

AUXILIARY DATA IDENTITY SHEET

Generic name: REFERENCE SCENE GRS IDENTIFICATION

Description: (K,J) coordinates of the reference scene (level S1 and S2).

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 2
- Record name: HEADER
- Byte numbers: 1509 to 1524

Coding type and unit:

- Coding type: 16 characters
- FORTRAN coding format: 2I3, 10X
- Unit:

Observations:

AUXILIARY DATA IDENTITY SHEET

Generic name: REFERENCE SCENE TIME

Description: date (to nearest millisecond) of reference scene (level S1 and S2).

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 2
- Record name: HEADER
- Byte numbers: 1,525 to 1,556

Coding type and unit:

- Coding type: 32 characters
- FORTRAN coding format: I4, 5I2, I3, 15X
- Unit: year, month, day, hour, second, millisecond

Observations:

AUXILIARY DATA IDENTITY SHEET

Generic name: REFERENCE SCENE SATELLITE IDENTIFICATION

Description: name and number of the satellite for the reference scene (level S1 and S2).

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 2
- Record name: HEADER
- Byte numbers: 1,557 to 1,572

Coding type and unit:

- Coding type: 16 characters
- FORTRAN coding format: A3, I1, 12X
- Unit: SPOTn, where n = SPOT satellite number

Observations:

AUXILIARY DATA IDENTITY SHEET

Generic name:	REFERENCE SCENE INSTRUMENT IDENTIFICATION
Description:	name and number of the HRV instrument for the reference scene (level S1 and S2).

Location on tape:

- File number:	2
- File name:	LEADER
- Record number:	2
- Record name:	HEADER
- Byte numbers:	1,573 to 1,588

Coding type and unit:

- Coding type:	16 characters
- FORTRAN coding format:	A3, I1, 12X
- Unit:	HRVn, where n = HRV instrument number

Observations:

AUXILIARY DATA IDENTITY SHEET

Generic name: REFERENCE SCENE SPECTRAL MODE

Description: spectral mode (multispectral or panchromatic) of the reference scene (level S1 and S2).

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 2
- Record name: HEADER
- Byte numbers: 1,589 to 1,604

Coding type and unit:

- Coding type: 16 characters
- FORTRAN coding format: A16
- Unit: equals XS or PAN

Observations:

AUXILIARY DATA IDENTITY SHEET

Generic name: REFERENCE SCENE PREPROCESSING LEVEL

Description: level at which the reference scene has been preprocessed (level S1 and S2).

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 2
- Record name: HEADER
- Byte numbers: 1,605 to 1,620

Coding type and unit:

- Coding type: 16 characters
- FORTRAN coding format: A16
- Unit: equals 1B or 2

Observations:

AUXILIARY DATA IDENTITY SHEET

Generic name: OFF-SET RELATIVE TO REFERENCE SCENE

Description: off-set of the first point on the first line of the scene with respect to the first point on the first line of the reference scene (level S1 and S2).

Location on tape:

- File number: 2
- File name: LEADER
- Record number: 2
- Record name: HEADER
- Byte numbers: 1,653 to 1,668

Coding type and unit:

- Coding type: 16 characters
- FORTRAN coding format: 2I8
- Unit: meters

Observations:

This off-set definition refers to the top left-hand corner of pixels (case of an image in XS mode with reference scene in P mode).